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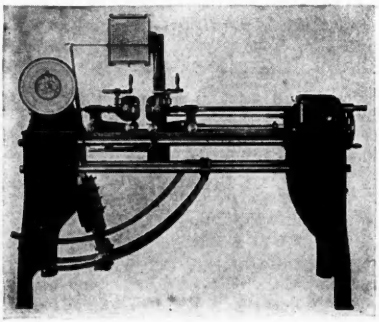

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STANDARD OF THE WORLD

Sun Spots, Ionization of Air and Textiles

By PETER M. STRANG

Introduction

DURING the spring months of 1938 and 1940 New England cotton mills had trouble in maintaining both the quality and production of their goods. Investigation showed that not only were cotton manufacturers having difficulty but spinners of rayon and wool were encountering similar production problems. At some of their conventions in the South manufacturers commented on a falling off in yarn strength and the fuzzy appearance of the yarns. The difficulties of manufacture do not seem to have been generally as extreme in the South as they were in the northern states.

In New England manufacturers suffered in that they could not maintain yarn strength, the spinning end breakage per M spindles per hour increased, loom efficiency unaccountably decreased, and quality suffered. A typical chart showing the decrease in yarn strength during these periods is shown in Figure 1. Complaints were very numerous about the quality of the cotton and the character of the current crop received severe condemnation. While it is known that the character of cotton materially affects the quality of yarn, a general condemnation of cotton could not explain the facts since rayon and wool manufacturers were also having trouble.

In one case the writer was able to demonstrate that the quality of the cotton used was not the major source of difficulty. When yarn strength fell off and the work ran poorly in 1938 at one mill, all difficulties were attributed to the cotton, but, since the cotton was bought and was on hand, it had to be used. The situation was different in 1940. Believing that a drop in yarn strength might be due to some seasonal disturbance caused by the sun, a twelve bale mix, sufficient to cover the requirements for three months, was arranged early in March. A mix is usually a blend of a definite number of bales of cotton of a fairly uniform grade, staple length, and character. For example, a mix might have one bale of Middling 1″ cotton from a shipping point in Arkansas, one bale of Middling 1″ cotton from a shipping point in Mississippi, etc. In this case all the bales originated in the same crop. In practice a set of twelve bales of a mix is laid out in the opening room, the bagging and ties are removed, and after conditioning in the air for a period, uniform portions from each bale are fed simultaneously to the opening machinery. The stock actually in process in the mill is thus kept fairly uniform. An exceptionally able cotton classer laid out the mix under consideration originally and then checked the individual bales used each day. It seems reasonable to eliminate cotton as a major source of trouble in this particular case because the mix produced satisfactory yarn for about a month before manufacturing difficulties and a decrease in yarn strength appeared.

While cotton was being condemned by some manufacturers, other textile men were blaming their troubles on mechanical adjustments in the factory, defects in the mill supplies used, the design and engineering of the machine equipment. The textile machine builders received their full quota of complaints. The builders were of course at a loss to reconcile why their equipment should produce a satisfactory product for many months and then suddenly be able to turn out only products of inferior

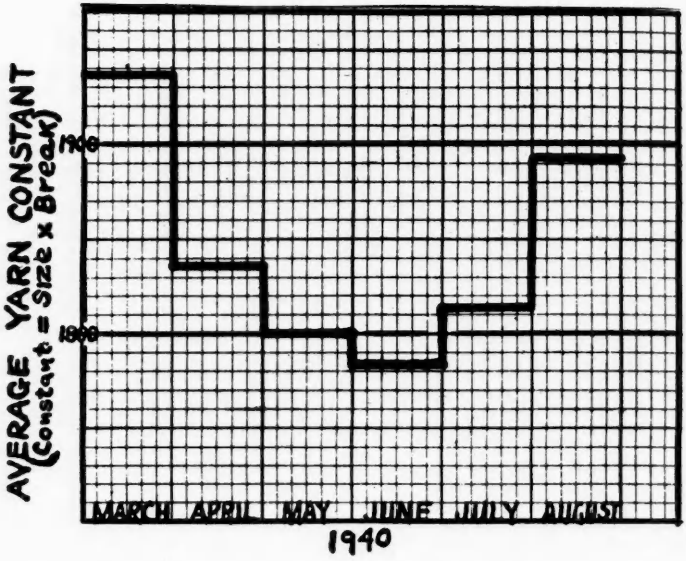

Fig. 1.

Typical chart showing change in yarn strength during springs of 1938–1940.

quality. After checking machine speeds, roll settings, drafts, the amounts of twist used, and other mechanical factors in the processes, the experts from a machine company in one instance contended that the only trouble they could find was with the cotton whereas the cotton department of this plant was able to prove that the same mix of cotton had been spinning satisfactorily for a month previous to the drop in yarn quality.

Air Ionization

As a coincidence, at the same time the New England textile industry was having difficulties in manufacture, the telephone, the telegraph, and the power companies were also experiencing unusual difficulties in the operation of their systems. Dr. A. G. McNish of the Carnegie Institution, in an article "Magnetic Storms,"[1] determined that magnetic storms caused by sun spots were the sources of the disturbances which bothered the oper-

ating electrical companies. When he states that "In equatorial regions effects of magnetic storms are least violent while at a distance from 20 degrees to 30 degrees from the magnetic poles they obtain their maximum intensity," his findings begin to be of interest to textile men as soon as they realize that the whole of their industry in the northeastern states lies either in or close to that belt of maximum intensity. On a map Dr. McNish shows the "Calculated Distribution of Induced Electromotive Forces in Eastern United States for the Magnetic Storm of March 24, 1940." Although the forces shown are calculated as the induced volts per mile on the transmission lines, a superposition of this map upon a Department of Commerce map showing the distribution of the textile industry in the United States (Figure 2) proves of great interest. It will be seen

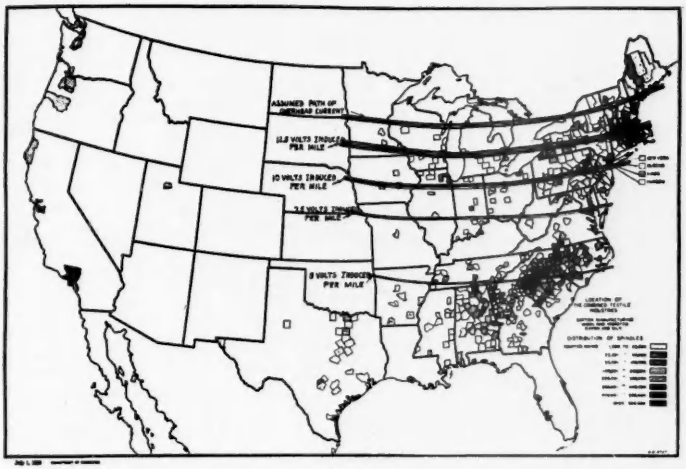
ASSUMED PATH OF OVERHEAD CURRENT
10 VOLTS INDUCED PER MILE
5 VOLTS INDUCED PER MILE
LOCATION OF THE COMBED TEXTILE INDUSTRY
DISTRIBUTION OF SPINDLES

Fig. 2.

Calculated distribution of induced electromotive forces on power lines by A. G. McNish for magnetic storm of March 24, 1940, superimposed on Department of Commerce map showing distribution of Textile Industry in the United States.

that the "Assumed Path of the Overhead Current" for the magnetic storm cut directly across northern New England and that the entire northeastern textile industry was in the region of maximum intensity of the storm. The whole textile industry was in territory affected by the storm. The band through central Pennsylvania shows that 10 volts were induced per mile; the band thru central Massachusetts shows that 12.5 volts were induced per mile; while the band to the north of Mississippi, Alabama, Georgia, and most of South Carolina shows that 5 volts were induced per mile. It appears that the effects of the magnetic storm were from 2 to 2.5 times greater in the northeastern textile areas than they were in four textile states in the South. Although the calculated induced electromotive forces on transmission lines are indicated, a corresponding variation would prob-

ably occur in the atmosphere and the atmosphere comes in actual contact with the textiles. The fact has been established that sun spot disturbances affect the atmosphere.

Since the great magnetic storm of March 24, 1940, occurred on a Sunday when most textile plants were closed, the question of any possible correlation between textile operation and the effects of sun spots arises. However, Dr. Clifford N. Anderson [2] of the Bell Laboratories furnishes a possible explanation when he states that the time required for the disturbing emission from the sun to reach the earth may be much greater than is usually assumed. The velocities of some of the particles from the sun are much less than the velocity of light which is 186,000 miles per second. The velocities of these particles may range from about 12 to 1,250 miles per second and the transit times from the sun may range from a few days to as much as three months. This explanation may reasonably account for the period of several weeks in which textile manufacturers had difficulties after the recorded effects of the magnetic storm on transmission lines.

In 1940 Glen Ireland [3] of the Bell Laboratories and L. W. Germaine of the American Telephone and Telegraph Co.[4] published articles disclosing that the major disturbances to the electrical systems not only occurred in the latitudes described by Dr. McNish but were most severe in regions of high earth resistivity in those latitudes. In ordinary parlance high earth resistivity means earth which does not easily allow an electrical charge to pass through it. The telephone companies find that usually more damage is caused by thunder storms in areas having high earth resistivity. In these areas lightning may jump from one conductor to another often showing visible flames and streamers and causes much damage because it cannot get to ground easily to dissipate itself.

Distribution of Textile Industry

The areas of high earth resistivity become of interest to the textile industry when it is realized that 90 per cent of the cotton mills, 90 per per cent of the wool and worsted plants, 80 per cent of the rayon and silk processing plants, and 75 per cent of the rayon producing plants are in these areas. The location of the textile industry in the United States has been occasioned by such reasons as cheap power, an adequate labor supply, nearness to raw materials, suitable transportation facilities, and the like. Figure 3 is a Bell Laboratory map showing areas of high earth resistivity. Figure 4 is a Department of Commerce map showing the distribution of the textile industry in the United States and Figure 5 is a superposition of the map of the areas of high earth resistivity upon the map showing the distribution of the textile industry. Figure 5 clearly demonstrates that but a small part of the industry is outside the areas of high earth resistivity.

The textile industry appears to be located in sections where the atmosphere is susceptible to electrical disturbances which vary in intensity from a minimum at the equator to a maximum near the Canadian border, and largely in sections of high earth resistivity. These are the sections in which the electrical distribution systems have their greatest difficulties because of magnetic storms and other atmospheric electrical disturbances. Indications are that mills in the same latitude from the magnetic north pole would have the same atmospheric electrical disturbances and conse-

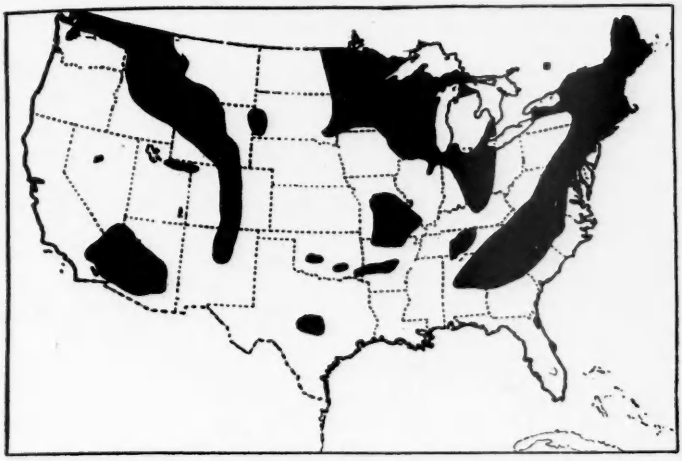

Fig. 3.

Map showing areas of high earth resistivity in the United States.

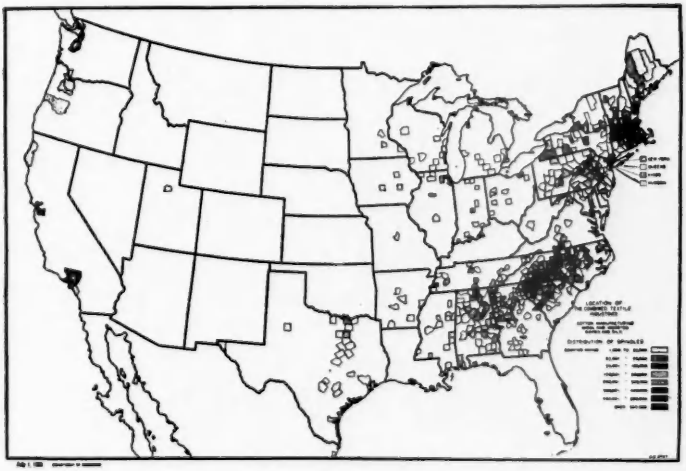

Fig. 4.

Department of Commerce map showing distribution of Textile Industry in the United States.

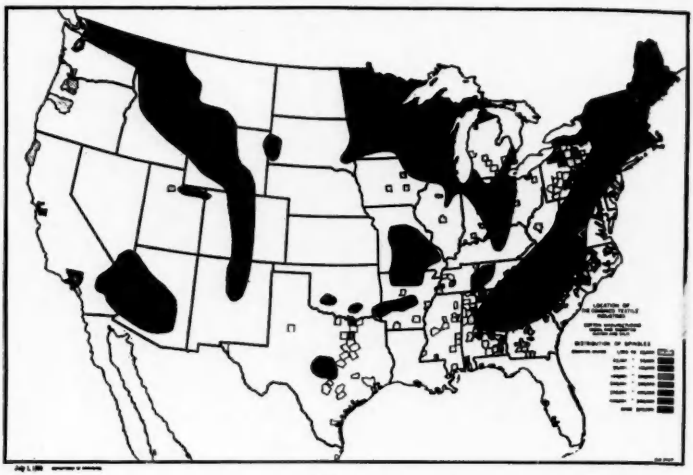

Fig. 5.

Superposition of map showing land of high earth resistivity upon Department of Commerce map showing distribution of Textile Industry in the United States.

quently the mills built on the land of the lowest earth resistivity should have the least trouble from this source. With mills on lands of equal resistivity ordinarily the southern mills should experience less trouble than the northern mills. G. Wascheck [5] of the Bell Laboratories has found that the resistivity of the earth ranges from about 1 to 10,000 meter-ohms. The resistivity in meter-ohms is the resistance between opposite faces of a cube one meter on a side. Since some of the highest measurements have been found in eastern Maine and northern Georgia—again in textile localities—the combined effects of earth resistivity and latitude can only be determined experimentally with each mill a separate problem. Many of the southern mills are on the Piedmont plateau with altitudes up to 1,100 feet. The question of altitude will be mentioned later in this paper.

Experience of Manufacturers

In the light of the experience and findings of the electrical companies, a review of some experience and a few random facts about the textile industry appear of interest with possibly an explanation.

As previously stated the maximum intensity of magnetic storms occurs at a distance between 20 degrees and 30 degrees from the geomagnetic poles. In the northern hemisphere the 20 degree circle from the magnetic pole approximately cuts through Winnipeg, and the center of Ontario. It includes the western and northern parts of Greenland and the eastern part of Alaska. The 30 degree circle intersects Portland, Maine; Concord, New Hampshire; Albany, New York; halves the state of Ohio, and to the west includes the entire states of Idaho and Washington and

most of Alaska. In the east all of Greenland and part of Iceland are included.

The entire European textile industry including that of Great Britain is outside the field of maximum intensity of the magnetic storms. Manchester, England, is in about the same latitude from the magnetic north pole as Brownsville, Texas, and the French and German industry in the same latitude as Mexico. There has long been a feeling by some that England and parts of Europe were able to produce yarns and fabrics which could not be duplicated in the United States. Any explanation to account for such yarns or fabrics is difficult. In Europe many cotton men believe that the best cotton grown in America is used by American mills and the remainder is exported. The textile machinery used is much the same whether made in America or Great Britain. There is British equipment in the United States and much equipment from the United States in Europe. British managers have come to the United States and their accomplishments have not been much different from those of native managers. The thought that European help may be inherently superior to the help in this country may also be promptly dismissed since Europe has furnished the United States with much textile labor. The moist climate of England has been considered an important reason for the production of quality textiles. Yet natural moisture is not wholly acceptable as an explanation because American engineers visiting other parts of Europe remark both upon the quality of the goods manufactured and the crudity of the equipment for maintaining humidity. Some of these same engineers have visited South America and have expressed amazement at the quality of manufacture in certain mills which had no humidification at all. These mills, however, were in the zone of the equator. The textile industries of Japan, China, and India are all in the zone of the geomagnetic equator.

Bearing in mind that New England and Ontario were in the zone of maximum intensity of the magnetic storm of 1940, it is interesting to note the following actual experiences during this spring. The operators of a group of mills in New England spinning and weaving staple rayon reported extreme trouble for which there seemed no reason. One mill in Ontario had to shut down some of its processes one morning during this period because excess static would not allow the fibers to draft properly. While a Massachusetts mill was having great difficulty in operating, a Georgia mill, using cotton from the same territories and purchased by the same buyer, reported but slight trouble. In Illinois, Ohio, and New Jersey, manufacturers carding bleached cotton reported great difficulty in maintaining the quality of their product. One day in April the writer accidentally found that the ordinary paper fiber sliver cans in the card room had large charges of static electricity on them.

Indications are that sun spots merely accentuate an atmospheric condition which normally affects textile manufacturing to a much less degree. It has been common practice for some mills in the Piedmont section of the South which regularly use for example 15/16″ cotton to segregate the longer cotton received during the year for use in May and June because it is believed that the longer stapled cotton aids in maintaining yarn strength and in overcoming a seasonal condition of static. One cotton mill in New England states that in order to maintain uniform operations more gear changes are required in March and September than at any other times of the year. The new cotton crop is not usually available in New England

until late October and so cannot be considered responsible for the changes. A manufacturer in Ontario states that normally the strength of his yarn decreases in March and several mill men have confirmed this statement. The engineer of a prominent air conditioning equipment company states that his company has had difficulty in duplicating test results in an air conditioned laboratory whose elevation is about 6,000 feet with the results obtained in similar laboratories elsewhere. An operator with factories in New England and the Piedmont has had difficulty in correlating yarn strength tests between the northern and southern plants. The southern plant has an elevation of about 1000 feet. R. J. McConnel of the Whitin Machine Works believes that in order to obtain the full benefit of daily yarn tests it is essential to wind the yarn at the same time of day, to condition the samples the same number of hours, and to break the yarn at the same time each day even when an air conditioned laboratory is available. An accepted truth in the textile industry is that the equipment and cotton that prove satisfactory to make a product in one plant will not necessarily produce equally satisfactory results in another plant. When textile factories operated but one shift, it was usually conceded that the work ran more smoothly in the afternoon than in the morning. The belief was that the equipment cooled off each night and needed the morning operation to warm up again to the most effective temperature.

Third Factor in Air Conditioning

The writer for some time has considered that in addition to temperature and humidity there is a third factor in air conditioning which affects textile fibers. Static has long been recognized as a hindrance in textile manufacture and its presence is indicated in yarn by fuzziness and a reduction in breaking strength. When yarns are broken to determine their strength, ordinarily but from ten to fifteen per cent of the fibers in a cross section are broken and the remainder slip apart. Previous work by the writer indicates that cotton fibers during processing acquire a negative electrical charge which, although reduced in quantity by temperature and humidity, may be dispersed throughout the fibers to a greater degree when the humidity is increased. When once the fibers become charged, it is extremely difficult to remove the charge. As a result when the fibers are twisted into yarn, friction and mechanical twist tend to bind them together while the electrical charges in the fibers, being of the same sign, tend to repel each other in accordance with Coulomb's law. The strength of the yarn will be the net difference between these two sets of forces. It seems quite probable that during the last twenty years the tendency to increase drafts and machine speeds and the introduction of rayon have caused the effects of static to be more noticeable in the textile industry than they were formerly.

Cyclic Behavior

R. H. Smith, Professor of Aeronautics at Massachusetts Institute of Technology, expressed the opinion that ionization of air was a factor which could affect textiles and whose variations seemed to be much the same as the variations in textile manufacture. While ionization of air and the effects of the sun on the Heaviside layer are not generally understood, it has been established that there is a daily cycle in the amount of ionization of the air

and there is also an annual cycle. The amounts of ionization vary with the latitude. They are at a minimum at the equator and increase towards the magnetic poles. The amounts of ionization at any place will also be dependent upon the altitude, the amount of foreign matter such as smoke, moisture, cloudiness, etc., in the atmosphere. A typical daily cycle in percentage variation of the ionization of the air is shown in Figure 6, an annual cycle in percentage variation is shown in Figure 7. As would be expected the spread of the daily cycle is much smaller than the spread of the annual cycle and is in fact about one third as great. The daily and annual variaton in textile manufacture and the variation in manufacture due to factory location seem to be parallel to the known variations of the ioniza-

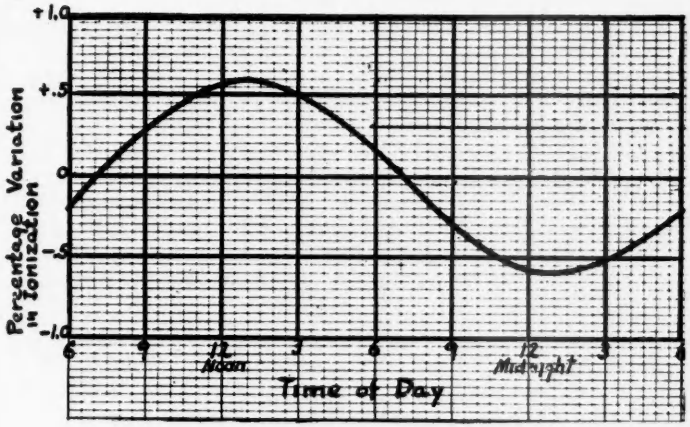

Fig. 6.

Typical chart showing daily percentage variation in ionization of air.

tion of air. The fluctuation in the ionization of the air offers an explanation as to why textile fibers behave differently in the divers sections of the country and throughout the day. The variation in ionization due to altitude may account in part for the differences in yarn tests made at different altitudes. The fact that the same cotton will not give yarn of equal quality throughout the year may be considered in light of the annual cycle in the ionization of the air. The reported varied effects of the magnetic storm seem to follow much the same pattern as the usual variations in ionization.

That a daily cycle in the behavior of cotton exists in certain manufacturing processes of one plant has been demonstrated by the writer. To determine whether or not the work load on the night shift was greater than on the other shifts, in the spinning room a series of spinning end breakage tests covering all three shifts was made. One spinner's set was checked for twenty-four consecutive hours and then the same procedure was followed on another set. A spinner's set consists of the number of frames

tended by one spinner and is the same for all shifts. The unit of comparison was the end breakage per thousand spindles per hour of running time. End breakage was calculated for each hour and frame down time was deducted. Temperature and humidity readings were taken every half hour and front roll speeds were taken hourly. A composite curve for fifteen of these twenty-four hour observations showing percentage hourly variation in spinning end breakage per thousand spindles per hour is given in Figure 8. A distinct daily cycle is indicated with the peak in the morning and the valley in the evening. A similarity between the curve showing the daily ionization cycle (Figure 6) and the daily change in end breakage is evident. However more studies are required with ionization curves and end

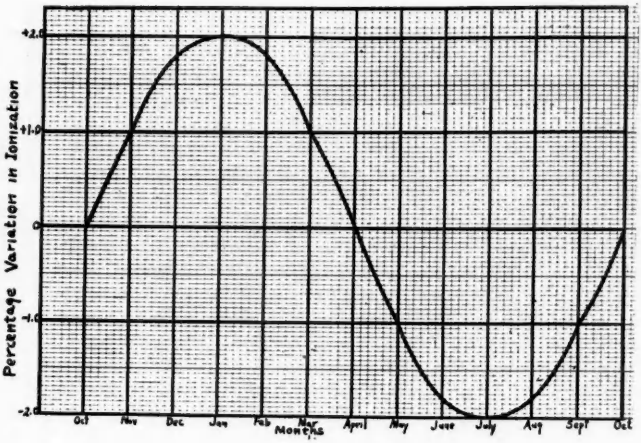

Fig. 7.

Typical chart showing annual percentage variation in ionization of air.

breakage charts made from data taken at the same time and place before close correlation can be determined. The end breakage observations were taken in groups in December 1938, March and September 1939, on identical sets. Both warp and filling frames were studied so that spindle speed, yarn package, size of spinning ring, and other such mechanical factors need not be considered. In fact the cycle was evident in two cases where the frames had been reduced in speed about five per cent between December and March. Cotton need not be considered a factor in the cycle in that only routine replacement of roving occurred in the spinning frames and ordinarily roving bobbins needed replacement only every five days. The human equation was eliminated as much as possible by having reliable spinners on each shift and during one series of checks the day spinners alternated every four hours from six in the morning until the night shift came on at ten in the evening. To overcome further the human element the spinners were made to patrol their frames at regularly timed intervals

on several days. In order to determine whether or not the cycle would continue on the same set for more than twenty-four hours one test was continued for thirty-two hours and the cycle was still evident. The data indicated that the change in end breakage was not due to radical changes in temperature or humidity as both these items were maintained at a fairly constant level. In fact during the tests three types of commercial controls and two types of air circulating equipment were tried. The cycle in end breakage obtained regardless of the temperature humidity controls used and regardless of whether there was mechanical or haphazard ventilation. The fact that the plant operated twenty-four hours a day six days a week and the machinery never had a chance to cool after it was

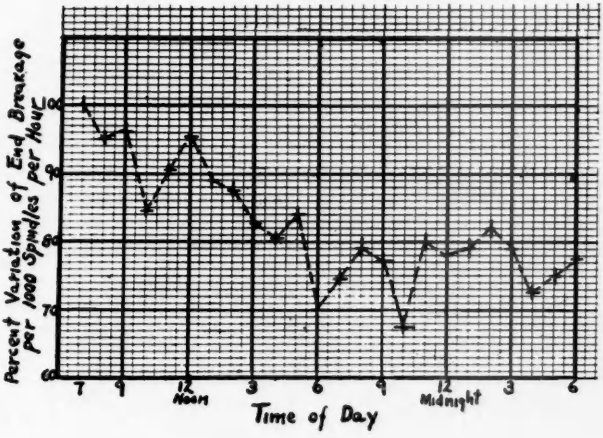

Fig. 8.

Chart showing percentage hourly variation in spinning edge breakage per thousand spindles per hour.

started, circumvented the old idea that warm machinery caused better running work in the afternoon. Eight similar twenty-four hour checks in the weave room furnished a curve which showed a variation in loom stops per hour very similar to the variation in spinning end breakage per hour. The curves for the spinning room and the weaving room were of the same pattern. The overseer of weaving maintained that in his experience loom stops per hour usually showed a sharp increase about sunrise and continued to increase until about noon. Independently and without knowledge of the above results, foremen in charge of the high speed warping and the tentering departments stated that usually their departments operated more smoothly in the afternoons.

The daily cycle in operation indicated proves of interest in that changes in radio reception are reported at sunrise and have been traced to the changes in ionization of the air. There are also changes in radio recep-

tion reported in March and September at which times the textile industry has to make adjustments. Further comparisons fail for lack of adequate data.

The object of this paper is to indicate the similarity between current and unexplained data in the textile industry and the recent findings of scientists concerning sun spots and the ionization of air. In view of the many variables in textile manufacture such as raw materials, machine speeds, age and type of equipment, quality of organization, type of product, etc., it is not easy to prove scientifically the effects of ionization on textiles in absolute units of comparison as can be done in the electrical industry. The material presented suggests many possibilities for reasoning and research. Ionization of air may afford southern mills an advantage in different machine speeds, less work per operative per pound of product, and less variation in quality of product over New England mills making comparable goods. The need of maintaining a supply of raw materials of uniform quality becomes more evident and if raw materials of poorer quality are acquired, they should be used at those times when the fewest ill effects will be noticed. In any national textile program results of research made in the South may not at once be applicable to the industry in the North. It may be that the textiles used for balloons to be moored at great altitudes as a barrage may not prove as effective in the northeastern states as they prove in England. There is the possibility that sun spots and ionization of air may in some way affect cotton fibers during their growth. At present the quality spinning cottons are produced on lands of low earth resistivity in the South while the Pima cotton from Arizona, whose character admittedly varies to a much greater extent than other cottons, is grown on land of high earth resistivity in a region where electrical companies have difficulties. Much correlated research is required.

Note. Thanks are due J. G. Patterson of the New England Telephone & Telegraph Co. for assistance in obtaining material for this paper.

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A Comparison of Five Methods of Measuring Fineness of Cotton Fibers

By MARY ANNA GRIMES *

Abstract

A comparison is made of five methods of determining the fineness of the fibres of each of five cottons. The methods used are weight per inch; area of cross sections; and widths of fibres collapsed, flooded with sodium hydroxide, and mercerized without tension. Identical fibres were used where methods permitted.

It is concluded that small differences may not be determined with certainty but that wide differences in fineness may be detected by any of these methods. It is suggested that the choice of method be made after deciding whether the area the fibre occupies or the quantity of material in the fibre is the information desired.

Introduction

Since the time when it became known that the fineness of cotton fibres affected the quality of the yarns, various methods have been used to measure fibre fineness. Judging from reports in current literature at least five methods for measuring fineness are now in use. These include the ribbon width of the fibres in their natural state, the width in sodium hydroxide, the width after mercerization without tension, the weight per unit length, and the area of cross sections. Recently another method in which the surface per gram of cotton fibre is used as a measure of fibre fineness has been suggested.[10] It is said that this method gives the same accuracy as the cross-sectional area method.

Experimental Procedure

Five length arrays of ⅛ inch interval were made for each of four lots of cotton and ten for the fifth cotton. Two groups of 100 fibres each from each ⅛ inch interval were counted from each array, weighed, and the average of the two weights determined. From these weights and lengths, using the method given by Richardson, Bailey and Conrad [5] the weight per inch of each group, and the weight per inch and the mean length of the whole array were computed for each array and for each cotton.

Preliminary determinations had shown that there was no significant difference in the widths as determined from the average of each length

* Textiles and Clothing Specialist, Texas Agricultural Experiment Station, Agricultural and Mechanical College, College Station, Texas. Approved for publication by the Director of the Station as Technical Contribution No. 676.

group and the width from the combined length groups, therefore the lengths were combined for a portion of the measurements of width in which case at least 250 fibres were measured. The three measurements of widths, collapsed, in sodium hydroxide, and after mercerization, were always obtained from identical fibres. The fibres were placed parallel on slides, held in place with cover glasses, and measurements made as nearly as possible at the midpoint between convolutions. Measurements were made with a Filar micrometer and a Euscope as assessories with the microscope.

Widths were determined for the cell wall and the lumen of the fibres (a) in their collapsed state, (b) when swollen in 18% sodium hydroxide and (c) after (b) followed by washing the fibres in distilled water and drying them, i.e., mercerized without tension. Thus measurements of fineness by each of four methods, weight and three width measurements, were obtained for these fibres. The ratios of width in sodium hydroxide to collapsed width, the ratios of mercerized to collapsed width, and the ratio of mercerized to width in sodium hydroxide were calculated to compare the responses of the cottons.

Since the same fibres which had been treated with sodium hydroxide could not also be cross sectioned in their natural state similar sets of 100 fibres which had also been weighed were used for cross sectioning. For a portion of the fibres the groups of 100 fibres of each length group in the arrays were combined and sectioned with a Hardy cross-sectioning device.[1] For three samples from each of the cottons A and B, each length group was sectioned separately using wool top to fill the remainder of the slot. For defective sections, or for those with indistinct outlines were substituted sections of fibres from the same length group of the array from which the sets of 100 fibres were taken. The sections were mounted in immersion oil as it appeared that the outlines of the fibres were more distinct than in any other mounting medium tried including Canada balsam, glycerine, mineral oil, olive oil, cotton seed oil, and kerosene. Cover glasses were sealed with colored collodion (nail polish). Each slide was examined through a Euscope, then if the sections were satisfactory, the slide was transferred to a projection microscope and the areas measured with a planimeter at magnifications previously determined with a stage micrometer after calibration of the microscope. A starting point on the outline of the fibres was marked with a pencil and the outline traced five times with the pointer of the planimeter. The five tracings no doubt reduced the errors which may have occurred due to slipping off to either side of the outline of the fibres. The total area was divided by five and this sum considered the true area of the cross section.

A carefully selected sample of the ginned cotton, including all lengths, was sectioned and the areas of 500 fibres measured. The average area of these fibres did not differ significantly from the average of the areas of the cotton at each length interval. It may be concluded that unless data are desired for each length group, an unarrayed sample may be used satisfactorily.

The thickness of the cell wall or stage of maturity of each fibre was determined with the polarizing microscope [6, 7, 8, 9] and the results checked by the sodium hydroxide method [5] or determined only with the polarizing microscope when the untreated fibres were to be cross sectioned. A preliminary study had revealed that there was no significant difference in the results obtained by the two methods. The maturity is expressed in two

ways, (a) by percentage of mature fibres and (b) by maturity index using the formula suggested by Hawkins.[2]

$$\text{Maturity index} = \frac{1.0\ \text{mature} + 0.5\ \text{partially mature} + 0.1\ \text{immature}^*}{\text{Number of fibres}}.$$

Results and Discussion

The average widths of all length groups of each of five samples of four cottons and of ten samples of the fifth cotton, with their respective weights per inch and maturity are given in table 1.

Table 1. Ribbon widths of each cotton collapsed, in sodium hydroxide, and mercerized, with corresponding weights per inch and maturity *

Cotton	Sample No.	Maturity		Weight micro-grams per in.	Ribbon Width in Microns				Ratios		
		%	Index		Collapsed	In NaOH	Mercer-ized	Mercerized width minus lumen	NaOH Collapsed	Mercerized Collapsed	Mercerized NaOH
A	1	72	.860	4.15	18.10	23.22	13.29	12.72	1.309	0.719	0.549
	2	56	.777	3.90	18.54	25.02	14.58	13.30	1.350	.786	.583
	3	83	.914	4.72	17.74	22.60	13.99	12.92	1.274	.788	.619
	4	53	.757	4.94	18.04	22.51	13.94	13.12	1.248	.773	.619
	5	68	.828	4.23	17.89	23.18	13.39	12.55	1.296	.748	.578
	Av.	66	.827	4.39 (2)	18.06 (1)	23.31 (1)	13.84 (1)	12.92 (1)	1.295	0.763	0.590
B	1	88	.899	6.50	21.21	27.59	16.98	16.09	1.301	0.800	0.615
	2	78	.889	5.24	21.60	28.74	15.40	14.09	1.331	.800	.536
	3	73	.861	5.40	21.01	26.13	15.58	14.94	1.244	.742	.596
	4	61	.785	6.05	22.47	28.55	15.76	14.78	1.271	.701	.552
	5	71	.839	5.14	20.11	26.46	15.89	15.30	1.238	.790	.600
	Av.	74	.855	5.67 (5)	21.28 (5)	27.49 (5)	15.92 (3)	15.04 (3)	1.277	0.767	0.580
C	1	60	.788	4.44	17.68	22.64	14.52	14.08	1.280	0.821	0.641
	2	73	.853	4.70	17.94	25.61	15.70	15.00	1.428	.875	.613
	3	84	.812	6.03	18.92	25.63	16.41	16.24	1.355	.867	.640
	4	84	.802	5.78	19.61	25.59	17.22	17.10	1.305	.878	.673
	5	68	.912	5.76	19.00	26.62	15.96	15.42	1.401	.840	.600
	Av.	74	.823	5.34 (4)	18.63 (3)	25.22 (3)	15.96 (4)	15.57 (4)	1.354	0.856	0.633
D	1	90	.947	4.68	17.85	23.95	15.66	14.58	1.342	0.877	0.654
	2	84	.915	3.68	19.16	24.81	16.04	14.75	1.295	.837	.646
	3	66	.822	3.54	18.66	25.53	15.37	14.36	1.366	.823	.602
	4	74	.859	4.58	18.52	24.93	16.02	14.20	1.346	.865	.642
	5	74	.855	4.57	17.67	23.24	15.15	14.70	1.315	.857	.652
	Av.	78	.880	4.21 (1)	18.38 (2)	24.49 (2)	15.65 (2)	14.52 (2)	1.333	0.852	0.639
E	1	82	.909	4.76	18.37	24.79	15.00	15.53	1.349	0.816	0.605
	2	81	.898	4.56	18.01	24.24	16.01	16.14	1.346	.889	.660
	3	57	.752	4.57	19.50	26.64	16.47	15.21	1.366	.845	.618
	4	83	.910	5.86	18.91	27.42	16.25	15.65	1.450	.859	.593
	5	80	.895	4.90	19.04	24.54	15.23	14.73	1.289	.800	.621
	6	62	.791	4.97	22.22	29.31	18.90	14.98	1.319	.851	.645
	7	71	.841	5.30	19.70	25.71	16.69	15.14	1.305	.847	.649
	8	92	.957	5.71	20.24	26.84	16.72	16.53	1.326	.826	.623
	9	77	.866	5.03	20.32	26.32	16.21	16.43	1.344	.896	.666
	10	81	.889	5.06	18.74	25.74	15.87	15.57	1.374	.847	.616
	Av.	77	.873	5.07 (3)	19.50 (4)	26.26 (4)	16.54 (5)	15.59 (5)	1.347	0.848	0.630

* The numbers in parentheses following the averages indicate the order in which the cottons rank in fineness by each method.

The weights per inch and the cross-sectional areas of identical fibres are given in Tables 2 and 3. In Table 2 are given measurements made at intervals of 2/16 inch from three arrays each of A and B. In Table 3 the lengths are grouped for C, D, and E.

The rather wide variations which sometimes occur between samples of the same cotton are no doubt due to the fact that each sample is from a

* Formula as corrected by author in personal communication.

single plant and not from a combination of fibres from all plants. Had all plants been combined the variation between samples would probably have been less. However the variations within a cotton do not affect the conclusions with respect to method of measuring fineness as comparisons are made of the same fibres.

Table 2. Maturity, area of cross section, and weight per inch at each length interval for A and B

A							B						
Length	Maturity		Area		Weight per inch		Length	Maturity		Area		Weight per inch	
1/16 in.	%	Index	Square microns	Coefficient of variability	Micrograms	Coefficient of variability	1/16 in.	%	Index	Square microns	Coefficient of variability	Micrograms	Coefficient of variability
23	76	.876	101	23.80	3.1								
21	74	.866	98	35.19	3.4								
19	82	.908	91	32.76	3.9								
17	79	.896	114	33.86	4.2		17	88	.940	134	31.80	5.1	
15	82	.910	124	28.34	4.7		15	94	.962	124	27.60	5.1	
13	66	.830	117	31.85	4.4		13	89	.955	140	29.60	6.2	
11	62	.808	127	31.56	4.7		11	92	.960	199	26.20	7.7	
9	72	.852	108	33.46	4.8		9	91	.966	182	34.10	8.4	
7	61	.793	94	46.67	4.8		7	78	.890	156	34.20	6.6	
5	59	.795	104	30.75	6.4		5	66	.830	153	40.60	7.0	
Average	71	.853	108		4.4		Average	85	.929	155		6.6	
Between lengths				11.14		20.59	Between lengths				17.26		18.79
23	60	.800	101	30.97	2.8								
21	61	.803	108	25.20	3.1								
19	74	.872	101	28.49	3.4								
17	65	.824	114	32.00	3.9		17	68	.822	140	39.39	4.7	
15	56	.774	124	29.62	4.1		15	69	.828	153	30.10	4.9	
13	54	.768	120	35.04	4.2		13	72	.848	163	31.18	5.2	
11	64	.820	120	31.67	4.7		11	69	.821	156	39.14	5.2	
9	52	.750	114	35.14	5.0		9	62	.778	153	45.99	5.7	
7	47	.723	91	36.80	4.3		7	87	.935	145	38.77	6.2	
5	44	.700	108	37.18	5.1		5	79	.879	156	39.79	8.6	
Average	56	.773	110		4.1		Average	72	.844	152		6.1	
Between lengths				9.38		18.80	Between lengths				5.24		26.5%
23	70	.850	124	30.56	3.3								
21	86	.930	120	25.77	3.9								
19	88	.939	124	24.49	4.2								
17	91	.955	140	28.57	4.7								
15	88	.939	134	25.60	4.9		15	80	.896	150	24.78	4.7	
13	76	.878	140	28.99	5.0		13	74	.871	140	28.64	5.2	
11	83	.915	156	32.28	6.1		11	69	.839	153	36.32	5.5	
9	77	.910	150	32.28	5.7		9	82	.908	169	34.46	6.8	
7	89	.937	134	34.02	5.9		7	86	.930	176	30.56	7.8	
5	79	.879	127	34.44	7.0		5	78	.893	169	34.82	7.7	
Average	83	.913	135		5.2		Average	78	.890	160		6.3	
Between lengths				8.66		23.86	Between lengths				8.69		21.11
Av. for 3 samples	70	.846	118		4.6		Av. for 3 samples	78	.888	156		6.3	
Between samples				12.75		12.47	Between samples				2.55		4.05

The order of the cottons with respect to fineness is not the same by all methods of measuring fineness. There is agreement between the widths when collapsed and when in sodium hydroxide, with A the finest cotton followed in order by D, C, E, and B as indicated by numbers in parentheses in Table 1. However by weight, D is slightly but not significantly finer than A, followed in order by E, C, and B.

When mercerized the order is A, D, B, C, and E. There are greater differences between cotton as measured by weight and area than by widths. The least difference is shown in the widths of mercerized fibres and the greatest in the weights. (Tables 1, 2 and 3.)

Tests were made of the significance of the differences between the

Table 3. The mean length, maturity, weight per inch, and area of cross section of C, D and E

Cotton	Mean length inches	Maturity		Area		Weight per inch	
		Per cent	Index	Square microns	Coefficient of variability	Micrograms	Coefficient of variability
C							
	0.98	60	.788	133	35.67	3.6	11.39
	1.03	73	.853	139	30.85	3.9	15.90
Average	1.00	66	.820	136		3.75	
Between samples					13.23		5.88
D							
	1.22	84	.915	117	34.76	3.2	14.06
	1.00	66	.822	117	34.26	2.9	17.93
	1.08	90	.947	131	28.90	4.2	14.76
Average	1.10	80	.895	122		3.43	
Between samples					7.10		20.05
E							
	0.83	82	.909	124	29.69	4.8	15.00
	1.02	81	.898	127	31.45	4.0	16.00
	.97	57	.752	150	31.76	3.8	13.68
	.96	80	.895	156	34.57	4.7	13.19
	.99	62	.791	163	31.89	4.8	14.58
	.87	71	.841	137	33.76	4.9	18.16
	1.01	84	.912	130	35.29	4.5	11.33
	.90	92	.957	147	32.66	5.4	11.48
	.88	77	.866	160	34.23	4.9	11.63
	.92	81	.889	143	31.59	4.9	15.51
	.89	76	.869	145	36.19	4.5	15.78
	.84	83	.910	147	35.11	5.3	13.21
Average	0.92	77	.874	144		4.74	
Between samples					8.76		9.87

cottons by each of four methods of determining fineness by calculating the t values which are given in Table. 4

When in the collapsed state only B differs significantly from all of the other cottons. In three of the four cases these differences are highly significant. In sodium hydroxide B differs significantly from only two cottons, A and D. There are significant differences between E and two other cottons, A and D, when in sodium hydroxide. When mercerized without tension the only significant differences between the cottons are those between A and the other cottons.

Significant differences in weight, with one exception, that between C and D, occur between the same cottons which show significant differences in width in sodium hydroxide. Thus the closest agreement, as measured by significant differences, was found between determinations by weight per inch and width in sodium hydroxide.

From these analyses it may be concluded that those cottons which are significantly different are A and B, A and E, B and D, and D and E, and that there are no significant differences between the other cottons.

The five cottons may be ranked in order of fineness using the seven sets of measurements for each as given in Tables 1, 2 and 3. In 5 of

Table 4. Significance of differences as shown by t values, between cottons by each of four methods of determining fineness.

Cotton	Collapsed Width				Width in NaOH			
	B	C	D	E	B	C	D	E
A	5.60†	1.02	.63	2.51	6.00†	2.35	1.95	4.40*
B		5.04†	6.14†	3.27*		2.65	4.51*	1.70
C			.56	1.66			.93	1.24
D				2.37				2.78*

Cotton	Width Mercerized				Mercerized width minus lumen			
	B	C	D	E	B	C	D	E
A	5.74†	4.23*	6.21†	6.00†	3.95*	3.96*	2.98*	5.72†
B		.08	.82	1.31		.86	1.12	1.45
C			.65	.99			1.71	.04
D				2.10				2.81*

Cotton	Weight per inch			
	B	C	D	E
A	3.95*	2.54	.61	2.87*
B		.80	4.22*	2.02
C			2.88*	.77
D				3.24*

* Exceeds t value at 5% level.
† Exceeds t value at 1% level.

the 7 measurements A is first, D second, and B fifth. In 4 cases E is fourth, C is ranked third in 3 cases and fourth in 3 cases, but in four cases E is fourth. It is concluded therefore that A is the finest cotton followed in order by D, C, E, and B but with little if any real difference between some of the cottons. The disagreements between weight and width cannot be accounted for by differences in the width of the lumen as agreement is no closer between the weight and the width after the lumen is subtracted.

It is perhaps not surprising that the ribbon widths and the weights per inch do not agree closely since they are not measures of the same thing. The ribbon width is a geometric measure of fineness and is dependent upon the perimenter and shape of the fibre. The weight is determined by the thickness of the secondary layer as well as by the perimeter. Two fibres may weigh the same but one have a larger perimenter with thin walls and the other a small perimenter with thick walls. If the secondary layer swells in sodium hydroxide and the extent of the swelling is determined by the cuticle or perimenter[4] then the fibre with the large perimeter would have a greater width than the fibre with the small perimeter although the weights are the same. It would seem that the perimeter of the round swollen or mercerized fibre and not the thickness of the secondary layer determines the fineness of the fibre as measured by ribbon width.

The widths of cotton fibres become greater when the fibres are flooded with sodium hydroxide, and become less when washed and dried after treating with sodium hydroxide (mercerized without tension), than in the collapsed state. To see if there might be a difference in the degree to which these five lots of cotton responded to the various treatments ratios were calculated. These are given in Table 1.

These ratios indicate that A and B did not expand as much in sodium hydroxide nor contract as much when mercerized as did C, D, and E. To see if there were significant differences in these responses to treatment t values were calculated, grouping the cottons according to similarity, using A and B as one group, C and D as another, and E as a third group. These t values are given in Table 5.

Table 5. Significance of differences between width ratios as shown by t values.

Between cottons	In NaOH / Collapsed	Mercerized / Collapsed	Mercerized / In NaOH
AB and CD	2.99*	7.45†	4.16†
AB and E	3.29†	5.70†	3.65†
CD and E	0.20	0.58	0.56

* Exceeds t value at 5% level.
† Exceeds t value at 1% level.

The t values show that A and B do differ significantly from C and D, and from E, but that C and D do not differ significantly from E in their response to treatment with sodium hydroxide. These differences are probably due to the fact that in general the wall occupies a larger percentage of the total width in C, D and E than in A and B as shown by comparison of collapsed widths with corresponding net mercerized widths, although these differences are not great enough to affect the maturity rating of the cottons.

Consideration of length with areas in Table 2 shows that in most cases the fibres with the greatest areas are not the shortest fibres, as might be expected, but occur near the middle of the array. The greatest ribbon widths likewise often occurred among the middle length groups. However with the exception of the first array of B the coarsest fibres by weight are in the two shortest groups. These differences in fineness by area and weight cannot be accounted for by differences in the percentage of mature fibres, as there were found to be no significant differences among the five cottons in the thickness of cell wall or stage of maturity. All were grown the same season and under identical environmental conditions. No varietal differences in maturity are indicated. Neither can the small areas of the short fibres be explained on the theory that these short fibres were pieces broken from the long fibres since the weights show them to be much coarser than the long fibres.

There are wide differences in average fineness of the five cottons by the two methods, weight per inch and cross-sectional areas. (Tables 2 and 3.) By weight per inch D is the finest followed in order by C, B, A, and E. By cross-sectional area A is finest followed in order by D, C, E, and B.

However, highly significant correlation coefficients between area and weight per inch were found: .503 for A, .583 for B and for the five cottons

.748. No doubt the coefficients between area and weight would be higher if the area of the lumen had been subtracted from the total area leaving only the area of the cell wall. The area would then have been a measure of the wall only as is the weight.

The correlation coefficients between weights and widths for all cottons are highly significant; weights with collapsed width .543, with width in sodium hydroxide .545 and with mercerized width .459. The correlation coefficient for weight and mercerzed width minus the lumen is .592 which is also highly significant but not as high as has been reported for other cottons [3] where apparently a wider range in fineness was included.

The correlation coefficients between length and area are —.158 for A, which is not significant, and —.534 for B which is significant. However the correlation coefficients between length and weight are —.833 for A and —.817 for B, both highly significant, showing a closer relationship between weight per inch and length than between area and length.

From this study it appears that small differences in fineness may not be determined with certainty but that wide differences may be detected by any of the methods used. It appears that the choice of method might be made on the basis of the information desired, i.e., whether it is the area the fibre occupies or the quantity of material present in the fibre and on the relation of each type of fineness to the spinning value. All of the methods employed are quite time consuming. If cross sections of the cotton in question can be compared with standards, i.e., cross sections of known areas as suggested by Karrer and Bailey,[3] this method would no doubt require the least time, particularly if separation of the fibres by length groups is not an essential part of the study.

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Inventory Management in Rayon Weaving

A Comparative Analysis of the Policies of Selling Styled and Staple Gray Goods from Stock and Production

Establishment of a unified statistical program, as "probably the greatest single step that the entire rayon-weaving industry could take to bring about a more intelligent control of all its operations," is suggested in the report of a study of INVENTORY MANAGEMENT IN RAYON WEAVING which has just been completed for the Textile Foundation.

The study is the fourth in a series of seven which the Industrial Research Department of the Wharton School of Finance and Commerce, University of Pennsylvania, is making for the Textile Foundation under the general title, INVENTORY POLICIES IN THE TEXTILE INDUSTRIES.

In suggesting the possibility of a unified statistical program, under the direction of an independent agency, with the sponsorship of the National Federation of Textiles, the National Rayon Weavers' Association, the Cotton-Textile Institute, the Textile Distributors' Institute, and the Textile Fabrics Association, the report points out that such a program could include virtually the entire rayon-weaving industry as well as a very substantial number of converters of rayon fabrics.

"The programs of the two rayon-weavers' associations arose largely out of the need for meeting problems peculiar to two different kinds of companies," the report states. "These company differences are no longer important and so it would seem that a merger of statistical efforts would now be timely."

"This analysis indicates that a working knowledge of past and future trends at the weaving and converting level can best be gained from statistics of mill billings, invoiced-and-held stocks, unsold stocks, and unfilled orders, and of converters' billings and stocks. A complete industry picture covering all of this material is of much greater use than several fragmentary ones."

"The complete picture could well be obtained if the suggestion for a single program were followed vigorously. It should permit a fuller coverage of the industry by eliminating duplicate reporting and by making cooperation in the program more worth while because of the greater confidence that could be placed in the data."

In addition to suggesting a unified statistical program, the study emphasizes that weavers of novelty-construction filament rayons have not been able to stabilize output by following a policy of selling gray and finished fabrics from stock. On the other hand, the study points out that weavers of rayon staples have been faced with many disadvantages by selling from

current or future production. Recommendations of far-reaching significance as to ways of avoiding some of the undesirable consequences of these policies are an important part of the study.

Besides the INVENTORY MANAGEMENT IN RAYON WEAVING, other studies in the series being made for the Textile Foundation deal with inventory management in the denim, cotton fine-goods, men's wear fabrics of wool, cotton print-cloth, and full-fashioned hosiery industries. The final number will summarize the six industry reports and discuss recent inventory trends in the production and distribution of textiles.

Copies of the 47-page study of INVENTORY MANAGEMENT IN RAYON WEAVING, as well as others in the series, may be obtained at fifty cents each from the Textile Foundation, Industrial Bldg., National Bureau of Standards, Washington, D. C. The Foundation is also accepting orders for the entire series at three dollars, individual studies to be mailed on publication.

Abstracts

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I. Fibers (Synthetic and Natural) and Fiber Analysis

Alginate Rayons: Production and Properties. J. B. Speakman. *Text. Mfr.*, 1940, V. 66, P. 464; abs. in *J. T. I.*, Feb. 1941, V. 32, P. A33.

Alginic acid, the raw material for alginate rayons, is extracted from seaweed with sodium carbonate solution. It is a polymer of *d*-mannuronic acid and its long-chain molecules carry free carboxyl groups at regular intervals along their length. Sodium alginate is soluble in water but insoluble salts are readily prepared by the double decomposition of sodium alginate and salts of bivalent and trivalent metals. Filaments are readily obtained by extruding sodium alginate through suitable spinnerettes into, say, calcium chloride solution. In this way yarns of satisfactory handle and appearance have been produced in counts varying from 3 denier per filament upwards, the whole process being based on the viscose system of manufacture. The number of possible alginate yarns is limited only by the number of metals which give insoluble salts with alginic acid. Many of the salts, e.g., those of copper, nickel and chromium are colored, and therefore of little commercial use. Calcium alginate is attacked and dissolved by alkali, even by a solution of soap and soda. It has been found possible to overcome this defect and yarns of satisfactory handle and appearance, possessing the necessary resistance to alkali, can now be produced. Because of their metal content, the alginate fibers are fireproof and should, therefore, find extensive use in furnishing fabrics. The maximum strength so far realized in yarns produced without stretch spinning is 2.25 g./denier at 65% R.H. and 72° F., but the strength is greatly aug-

mented by stretch spinning methods, and the wet strength is as high as 60% of the strength at 65% R.H. The fibers have a high affinity for water, rather greater than that of wool, and should be useful for the manufacture of underclothing. Spun dyed yarns are readily obtained, and the possibility of obtaining novelty effects is increased by the fact that the dyeing properties of alginate yarns in general vary in accordance with the metals they contain. (C)

CONSTITUTION OF SILK FIBROIN. K. H. Meyer, M. Fuld, and O. Klemm. *Helv. Chim. Acta*, 1940, V. 23, P. 1441–44; abs. in *J. Soc. Dyers Col.*, April 1941, V. 57, P. 129.

Analytical investigation of the constitution of silk fibroin by Bergmann and Niemann (*J. Biol. Chem.*, 1936, V. 115, P. 77; 1937, V. 118, P. 301) indicates that it possesses a periodic arrangement of amino-acids, and that in the polypeptide chain every second residue consists of glycocoll, every fourth of alanine and every sixth of tyrosine. These results are a contradiction of the results of X-ray analysis, because silk gives an X-ray diagram which indicates that in the crystalline region identical arrangements of two amino-acid residues are repeated along the axis of the fiber. A simpler explanation is that in the interior of the crystallites the glycocoll and alanine residues alternate along a chain of principal valencies, and that alanine can probably be replaced by serine which has almost the same dimensions. Residues of other amino-acids do not occur in the crystallites, but are located outside them. The present authors have determined the tyrosine content of fibroin from purified silk, and have found that it amounts to only 10.8%. The higher value, viz. 13.2%, obtained by Bergmann and Niemann (*loc. cit.*) is attributed to the presence of impurities, probably phenylalanine and leucine, in the tyrosine. The figure, 10.8%, is not compatible with the periodicity suggested by Bergmann and Niemann, because the tyrosine does not constitute every sixth, but every fifth, residue, and, moreover, the tyrosine content of the fibroin varies between 11% and 3.6% according to the origin of the silk. Further investigations have indicated that it is extremely unlikely that the tyrosine is substituted by an alanine residue, because the tyrosine molecule is much more voluminous than that of alanine. Moreover, if the tyrosine residue forms part of the crystalline network, the X-ray diagram should be modified on coupling with a diazo compound, but, as this is not the case, it is concluded that the tyrosine is distributed outside the crystallites. The X-ray interference bands of natural silk indicate that the crystallites are very long, and include at least six identical periods along the fiber axis. (C)

ELECTRON-MICROSCOPE STUDIES OF THE DEGRADATION OF CELLULOSE FIBERS. H. Ruska and M. Kretschmer. *Kolloid Z.*, November 1940, V. 93, No. 2, P. 163–66; abs. in *Eastman Kodak Abs. Bull.*, March 1941, P. 114.

The degradation of cellulose fibers by the action of salt solutions and precipitation from cuprammonium solution was observed using a Siemens electron-microscope. A foamy, amorphous-like, submicroscopic structure was evident, which, in part, resembled the aggregation of inner fibers. In the outer zone of these (inner) fibers were discerned systems formed of variable-length filaments which were of the order of magnitude of cellulose micelles as determined by x-ray studies. (S)

II. Yarns and Fabrics

Moistureproofing Rayon and Silk Fabrics. Practical Aspects Governing Future Scope. *Silk J. & Rayon Wld.*, March 1941, V. 17, P. 20–1.

In spite of the fact that processes such as that of "Velanisation" are in the logical direction of progress towards perfect fiber water-repellency, it is the author's opinion that for practical purposes there still remains an exceedingly wide field for the application to rayon and silk fabrics of the newer one-bath porous impregnation processes. This article sketches the defects of older processes and how newer ones have overcome them. (C)

Resistance of Wool Goods to Shrinkage. "Scrutator." *Canadian Text. J.*, V. 58, No. 9, P. 31–2.

This is the second in the series of articles by "Scrutator" outlining trends in modern textile research and processing, the first of which discussed "Water Repellency in Textiles" and appeared in the April 11th issue. The subject of unshrinkable wool is now of particular interest, especially in relation to war materials. Current research is along the lines of developing processes which will produce the desired results without damaging the fiber. (C)

Scientific Attitude—From the Raw Material to the Ultimate Consumer. Joseph Givner. *Text. Bull.*, V. 60, No. 4, P. 17, 18, 53.

In advocating greater standardization of products, the author writes, "Shall we make more and more new fabrics unlike the old so that more and more laboratories are needed to find out what one is buying and what the fabric will do? It is like politicians setting more and more laws so that more and more lawyers are needed to know what one can do." (C)

The Spinning of Dyed and Bleached Yarns. G. Ullmann. *J. T. I.*, Feb. 1941, V. 32, P. P1–P11.

The present article describes the steps of bleaching, dyeing and spinning involved in this rather complicated branch of yarn production, indicates the types of goods for which the yarns are to be chiefly recommended, and discusses questions of cost. The methods under review were for the most part developed by the author himself or with his collaboration. (C)

Staple Fiber to Yarn. Carl D. Brandt. *Rayon Text. Mo.*, May 1941, V. 22, P. 62–4. (C)

Synthetic Fibers in the Wool Industries. R. S. Greenwood and W. Hardacre. *Text. Mfr.*, April 1941, V. 67, P. 125–26.

"Fibro" types of staple fibers and their uses in the wool industries and trade; some factors in the construction of spun rayon fabrics of wool-type. (C)

Yarn Preparation and Its Relation to Dyeing and Finishing. George A. Urlaub. *Am. Dye. Reptr.*, 1941, V. 30, No. 8, P. P206–P210. (C)

III. Chemical and Other Processing (Not Otherwise Classified)

Dyed Fabrics; Production of Spin Eruptions and Photosensitivity by —. E. Epstein. *Arch. Dermat. & Syph.*, 1940, V. 41, P. 1044–52; *Bull. Hygiene*, 1940, V. 15, P. 670; abs. in *J. T. I.*, Feb. 1941, V. 32, P. A92.

Skin eruptions due to clothing occur frequently enough to be worthy of serious consideration. Most of the harmful dyes are water soluble. Perspiration plays an important role by dissolving the dye and the garment may only cause trouble in hot weather. Instances are quoted of dermatitis set up by a new blue rayon dress, a light blue polo shirt and a blue slip-on sweater, blue canvas tennis shoes, and a brown suit. Paraphenylenediamine is, perhaps, the dye most often at fault. A pair of rayon pyjamas with red and purple stripes set up photosensitivity which sunlight converted into severe erythema of ears, eyelids, cheeks and nose, while parts covered by the nose-piece of glasses remained unaffected. A similar condition was caused by a pair of dark blue trousers. The bluish-grey shirt of a letter carrier and the blue sweater of a Chinaman originated pyoderma. Workers in clothing factories may experience dermatities from contact with dyed fabrics. Patients may be sensitive to a single dye only and not react to closely related ones. (C)

Dyeing of Army Socks. Albert H. Grimshaw. *Text. Wld.*, April 1941, V. 91, P. 65.

Data on formulas and methods for producing tan shade with vat colors on cotton hose. (C)

Dyeing Cotton with Basic Dyestuffs. G. S. Ranshaw. *Text. Recdr.*, April 1941, V. 58, P. 31–33. (C)

Dyeing and Finishing Rayon Hosiery. II. Delustring. "Midlander." *Silk J. & Rayon Wld.*, March 1941, V. 17, P. 29–30. (C)

The Dyeing of Vat Tan Colors on Government Contract. *Cotton*, April 1941, V. 105, P. 141–42.

The procedure described here, for dyeing vat tan on government contract socks, should be of especial interest to mills running anklets and children's hose. There are a number of colors in this type of goods that, due to brightness of color, must be knit ingrain. A small amount of experimenting, based on the methods given here, should develop an entirely satisfactory dyeing method for these colors. (C)

The Effect of Modern Finishing Agents on the Light Fastness of Cotton Colors. *Am. Dye. Rptr.*, 1941, V. 30, No. 6, P. P146–47.

This is a discussion which took place at a meeting of the Northern New England Section of the A. A. T. C. C. on Dec. 20, 1940, of the paper presented by William H. Cady for the Rhode Island Section in the Intersec-

tional Contest at the Twentieth Annual Meeting in New York and repeated at the meeting of the Northern New England Section. The discussion was introduced by a paper written by Dr. Robert E. Rose of E. I. du Pont de Nemours & Co., Inc., and followed by another paper presented by Mr. Robert R. Ackley of the Onyx Oil & Chemical Co., Fellow, Mellon Institute of Industrial Research. (C)

ETHYLENE OXIDE: USE IN THE TREATMENT OF TEXTILE MATERIALS. *Text. Mercury*, 1940, V. 103, P. 307, 309; abs. in *J. T. I.*, Nov. 1940, V. 31, P. A613.

The preparation and properties of ethylene oxide are briefly discussed and a short account is given of the use of this compound in the preparation of wetting agents, such as Peregal O, sizing products, and hydroxyalkyl cellulose ethers, and in the production of transparent effects and organdie finishes on cotton fabrics. (C)

THE FABRIC THEORY OF PROTEIN STRUCTURE. D. Wrinch. *Phil. Mag.*, July 1940, V. 30, P. 64–7; abs. in *Eastman Kodak Abs. Bull.*, April 1941, P. 152.

The lactam-lactim transformation postulated in the original cyclol theory is now replaced by a suggested keto-enol transformation. Certain of the amino- and imino-acid residues in the native proteins are considered to function in the enol and not in the classical keto form. The nature of such a fabric is briefly indicated, a full discussion being reserved for future publication. (S)

AN IMPROVED AZOIC COLOR PRINTING PROCESS FOR COTTON AND RAYON FABRICS. Celltex. *Silk & Rayon*, March 1941, V. 15, P. 184. (C)

pH AND DETERGENCY. Malcolm Dole. *Am. Dye. Rptr.*, 1941, V. 30, No. 9, P. 231–38.

The data presented indicate that there is a definite relationship between pH and detergency, but it should be remembered that the total alkaline capacity of the soap solution, which can be measured only by titration, is also important. (C)

PREPARATION FOR THE DYEING OF WOOL RAW STOCK. Charles F. E. Sedgwick. *Am. Dye. Rptr.*, 1941, V. 30, No. 8, P. P200, P201, P203. (C)

PROCESSING SPUN RAYON PIECE GOODS. C. R. Stockton. *Text. Bull.*, V. 60, No. 4, P. 39–41. (C)

PROGRESS IN PACKAGE YARN DYEING. W. A. Traver. *Canadian Text. J.*, 1941, V. 58, No. 10, P. 35, 36, 38, 48, 49.

Modern, stainless steel machines now employed for wider ranges of weaving, knitting and specialty yarns. Simplicity of machine design and durability of parts are recommended for economy and efficiency. Highly soluble dyestuffs and chemicals and soft water assist in obtaining level shades. (C)

IV. Research Methods and Apparatus

The Determination of Twist in Single Worsted, Woolen and Staple Fiber Yarns. Investigator. *Silk & Rayon*, March 1941, V. 15, P. 166, 170. (C)

Estimation of Textile Soaps and Oleins. *Text. Recdr.*, March 1941, V. 58, P. 31–2.

Significance of acid, saponification and iodine numbers. (C)

Fabric Abrasion Comparator. K. N. Mathes. *General Electric Rev.*, 1940, V. 43, P. 467–470; abs. in *J. T. I.*, Feb. 1941, V. 32, P. A69.

A device for testing the effects of abrasion on insulating fabrics is described and its use for the evaluation of such materials is discussed. The fabric, tape or sheet is wrapped about a ⅜ in. square brass mandrel and suitably fastened. One or more thicknesses of material may be tested as desired. One end of the brass mandrel is inserted in a chuck which can be rotated at 60 r.p.m. A washer of a very hard metallic material is slipped over the end of the mandrel and laterally held in place on the insulation by a slotted guide. The load to produce the desired pressure between the washer and insulation is suspended from the washer by an elastic rubber suspension. As the sample rotates the washer rubs over the surface of the insulation. When the washer finally wears through the insulation to one of the edges of the mandrel, electrical contact is established between the washer and mandrel through a low-current relay which acts automatically to stop the electric motor driving the test mandrel. The number of turns required to wear through the insulation is taken as a measure of its abrasion resistance. The influence of tensile strength and the effects of pressure, thickness, varnish treatment, and exposure to heat and chemicals on abrasion resistance are discussed, and results are given for cotton, asbestos, cellulose acetate, and glass fiber insulating materials. (C)

Fish Protein Mixture Filaments: Tensile Properties. T. Tadokoro and M. Nishida. *J. Soc. Chem. Ind. Japan*, 1940, V. 43, P. 347B.

The strength of casein filaments containing fish protein decreased on storage at — 22° C. for more than 24 hours. The extensibility of viscose filaments containing fish protein was doubled by the addition of chitin, and the strength was increased by using urea instead of alkali to dissolve the fish protein. Such viscose mixture filaments are much finer than casein filaments. (C)

Hydrogen-ion Concentration Measurement Equipment. *Engineering*, 1941, V. 151, P. 21–23, 64–5; abs. in *J. T. I.*, March 1941, V. 32, P. A129.

The measurement of hydrogen-ion concentration, the theory underlying such measurements, and advantages, limitations and applications of hydrogen, quinhydrone, antimony and glass electrodes for *p*H measurements are discussed. Measuring instruments and recording and controlling systems that employ glass electrodes are described and metallurgical applications are briefly discussed. (C)

V. Pure Science, Economics and Misc.

The Dissolution of Chemically Modified Cotton Cellulose in Alkaline Solutions. VI. The Effect of the Method of Modification on the Relation between Fractional Solubility in Sodium Hydroxide Solution and Fluidity in Cuprammonium Solution. T. Brownsett and G. F. Davidson. *J. T. I.*, Feb. 1941, V. 32, P. T25–T31.

The effect of the method of modification on the relation between the fluidity in cuprammonium solution of chemically modified cotton celluloses and their fractional solubility in 2.5*N* sodium hydroxide solution at — 5° C. has been investigated. Oxycelluloses prepared by the action of alkaline hypobromite or alkaline hypochlorite, or of dichromate in the presence of sulphuric or oxalic acid, give approximately the same fluidity-solubility relation as hydrocelluloses, but neutral hypochlorite and acid hypochlorite oxycelluloses are considerably more soluble, and periodic acid and metaperiodate oxycelluloses considerably less soluble, than hydrocelluloses of equal fluidity. Treatment of the modified cottons with cold or hot dilute sodium hydroxide solution produces changes of fluidity and solubility that vary in magnitude from one type of modified cotton to another, and after these treatments the relation between the two properties is the same whatever the method of modification. Periodic acid and metaperiodate oxycelluloses are exceptional in showing relatively large increases of solubility as a result of pre-treatment with cold dilute sodium hydroxide solution, and this behavior is ascribed to the presence in these oxycelluloses of alkali-sensitive linkages that are not broken by the relatively short alkali treatment involved in the solubility measurement. The abnormal fluidity-solubility relation given by the neutral hypochlorite and acid hypochlorite oxycelluloses is due mainly to an abnormality in the behavior of these types of modified cotton towards cuprammonium. (C)

The Estimation of Histidine. R. J. Block. *J. Biol. Chem.*, March 1940, V. 133, P. 67–9; abs. in *Eastman Kodak Abs. Bull.*, Feb. 1941, P. 66.

A detailed description is given of the nitranilic acid method of estimating histidine. (S)

Fluorescent Lighting for the Textile Industry. Harris Reinhardt. *Am. Dye. Rptr.*, 1941, V. 30, No. 5, P. P123–P126. (C)

The Formation of Polymerized Compounds of High Molecular Weight. Orlando A. Battista. *Rayon Text. Mo.*, Dec. 1940, V. 21, P. 40–1. (C)

The Mechanism of Water Adsorption in Gelatin Gel. A. Weidinger and H. Pelser. *Reç. trav. chim.*, January 1940, V. 59, P. 64–72; abs. in *Eastman Kodak Abs. Bull.*, March 1941, P. 114.

An attempt is made to bring into closer correlation the conceptions of "bound" and "intramicellar" water. Gelatins plus cobaltous chloride were studied. Color, moisture regain, and side-chain spacings were determined. The change in color from purple to red coincides completely with the point at which the side-chain spacing ceases to increase on continued water adsorption. Bound water corresponds with intramicellar water and free water with intermicellar water. On the first traject of the adsorp-

tion curve, water is taken up only intramicellarly, intermicellar adsorption setting in only after complete saturation of the micelles with water. In gelatin gels of low cobaltous chloride content, all the cobaltous chloride is stored intermicellarly and does not interfere with intramicellar water adsorption. In gels of high cobaltous chloride content, the salt seems to intrude somewhat within the micelle and increases the intramicellar water adsorption. (S)

A New Color Reaction of Amino Acids. S. Edlbacher and F. Litvan. *Hoppe-Seyler's Z. physiol. Chem.*, 1940, V. 265, No. 4, 5, and 6, P. 241–43; abs. in *Eastman Kodak Abs. Bull.*, Feb. 1941, P. 65.

A color reaction based on the colors developed by amino acids and benzoylating agents in the presence of pyridine or similar compounds, such as picoline or quinoline, is described. (S)

Nylon Stockings: Dermatitis following Wear of—. *J. Amer. Med. Assoc.*, 1940, V. 115, P. 354–5; *Bull. Hygiene*, 1940, V. 15, P. 670; abs. in *J. T. I.*, Feb. 1941, V. 32, P. A92.

Four cases of moderately severe pruritic folliculo-papular dermatitis were seen by the author. The patients were women and the lesions were limited to the legs and thighs. All four wore Nylon stockings. The yarn is manufactured by one company and is sent to various mills where it is made into hosiery, dyed and finished. The dyes used are the same as those for cellulose acetate material, and the "finishing" is accomplished by treatment with some softening agent, such as a sulphonated oil, a soap, or an oil emulsion. From the appearance of the rash the author concludes that the noxious agent is dissolved by perspiration and then absorbed via the hair follicles. All four patients reacted strongly to the finished product and to an ether extract, but not to the yarn undyed or unfinished. The cause is, therefore, probably the dye or something used in the finish, and this is supported by the fact that all four patients were wearing hose from one manufacturer. (C)

Observations on the Permeability of Hygroscopic Materials to Water Vapor: Observations at Relative Humidities Less than 75 per cent. J. D. Babbitt. *Canadian J. Research*, June 1940, V. 18, P. 105–21; abs. in *Eastman Kodak Abs. Bull.*, January 1941, P. 29.

Measurements for fiberboards show that the resistance to moisture transmission from 75 % R. H. on one side to 0% R. H. on the other side is directly proportional to the thickness. The moisture content gradients through the fiberboards were determined by weighing and drying small sections cut parallel to the faces. The diffusion through a board in which the moisture-content gradient opposed the vapor-pressure gradient indicates that the latter was the important factor. (S)

Polyamide Resins. *Brit. Plastics*, June 1940, V. 12, P. 24 (See *Ibid.*, February 1940, V. 12, P. 400); abs. in *Eastman Kodak Abs. Bull.*, January 1941, P. 31.

The solubility, melting point, fiber- and film-forming properties of various types of polyamide resins are reviewed. (S)